

The FUNction Machine

Reporting Category Patterns, Functions and Algebra

Topic Understanding patterns and functional relationships through identifying, analyzing, and extending patterns.

Materials

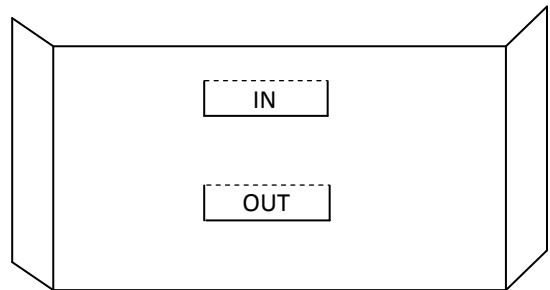
- FUNction Machine (see below)
- Square-inch tiles or linking cubes
- FUNction Machine Mat (attached)
- FUNction Machine Recording Sheet (attached)

Vocabulary

addition, addend, subtraction, subtrahend, pattern, function

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

Note: Before undertaking this activity, construct a FUNction Machine from project board or an empty box (diagram at right). Cut a flap in the top third of the board or box side, and label it "IN." Cut another flap in the bottom third of the board or box side, and label it "OUT." Decorate as you wish.



1. Show students the FUNction Machine, and explain that they will be using it to discover some number patterns. Explain that when a number of cubes are put in the IN flap, the machine will change the number according to a rule or pattern, and a different number of cubes will come out of the OUT flap. Machine operators must figure out the rule or pattern the machine is following. At first, the teacher will be the machine operator, but as students become accustomed to using the machine, they will take over as operators and recorders.

2. Draw a T-chart on the board with the headings "IN" and "OUT" to use for recording the workings of the machine. Select a student to come up and place 3 cubes in the IN flap. Record 3 on the IN section of the chart. Then, make 5 cubes come out of the machine from the OUT flap. Record 5 on the OUT section of the chart. Ask students to think about what happened.

IN	OUT
3	5

3. Select another student to come up and place 5 cubes in the IN flap. Record 5 on the IN section of the chart. Then, make 7 cubes come out of the machine from the OUT flap. Record 7 on the OUT section of the chart. Ask students to think independently and then discuss with a partner what happened.

IN	OUT
3	5
5	7

4. Ask what happened to the number of cubes that went into the IN flap? (The number got bigger each time, so we know the machine is adding cubes.) Ask whether there is a pattern to how many cubes the machine added each time, and if so, what the pattern is. Tell students that to figure out the pattern or rule, we can write a number sentence and represent the unknown number with a blank (see sentences at right). Ask what number can go in the blank that will make each number sentence true, and ask students to predict this number.

IN	OUT	
3	5	$3 + \underline{\quad} = 5$
5	7	$5 + \underline{\quad} = 7$

5. Select another student to come up and place a different number of cubes in the IN flap. Record the number on the IN section of the chart, and make two more than this number of cubes come out of the machine from the OUT flap. Record this number on the OUT section of the chart. Have students construct a number sentence to express what happened this time. Ask whether the predicted number is still true. Have students state the pattern or rule by filling in the missing addend in the blanks of all three number sentences, and have them verbalize and explain the +2 rule.

6. Display another T-chart and repeat the process with a subtraction pattern or rule. The example at right shows a -3 rule.

IN	OUT	
6	3	$6 - \underline{\quad} = 3$
5	2	$5 - \underline{\quad} = 2$
3	0	$3 - \underline{\quad} = 0$

7. Arrange students in small groups or pairs. Give students cubes, copies of the FUNction Machine Mat, and copies of the FUNction Machine Recording Sheet. Direct students to take turns thinking up their own patterns or rules, repeating the activity with the mat and recording everything on the recording sheet.
8. Review and summarize with the class what students did and learned in the activity.

Assessment

• Questions

- How can an unknown number be represented in a number sentence?
- What is the relationship between addition and subtraction?
- Some number patterns involve addition, and some involve subtraction. What are the clues to look for that tell if addition or subtraction is being used?
- If someone were having trouble figuring out the rule or pattern, what kinds of strategies could they use to help them?
- How are skip counting and number patterns related?

• Journal/Writing Prompts

- Trina has some pencils that she is giving to her friends Josh, Chris, and Susan. Josh has 4 pencils, and after Trina gives him some more, he has 7. Chris has 6 pencils and Susan has 2. Trina gives them some more, and then Chris has 9 and Susan has 5. How many pencils is Trina giving to her friends? Explain how you know.
- Glenn is playing with the FUNction Machine. He starts by putting 6 cubes into the machine, and 4 cubes come out. Next, he puts 8 cubes in the machine, and 6 come out. Glenn thinks he knows the pattern, but he wants to check his prediction, so he puts 3 cubes into the machine. How many cubes will come out of the machine this time? What is the pattern? Explain how you know.

- **Other**

- As students are working, observe their strategies and rationales for determining the patterns. Encourage the use of various strategies, and allow time for student discussion and justification. Note who is having difficulty identifying patterns, making accurate predictions, and creating the missing addend or subtrahend problems. Give help, as necessary.
- Occasionally stop the activity and have students answer the following question: "How well do I understand what I am doing?" Have students respond by showing thumbs up ("I get it."), sideways thumbs ("I kind of understand."), or thumbs down ("I'm still confused."). Give help, as needed.
- Have students create story problems and exchange them with partners to answer. Direct students to write their names on both papers, indicating who created the problems and who solved them. Collect problems as an assessment.

Extensions and Connections (for all students)

- Have students use the large FUNction Machine, or have them create their own mini versions, using two file folders stapled together and having two slots instead of flaps. Student pairs may use the FUNction Machine as a learning center activity.
- Teach students how to use a calculator as a mini FUNction Machine.

Strategies for Differentiation

- Let students discover, record, and explain the patterns, using a hundred chart or a number line to record the IN and OUT numbers.
- Provide counters for students to use during the activity to model what the FUNction Machine is doing to change the IN number.



FUNction Machine Recording Sheet

Rule _____	
IN	OUT

Write the number sentence showing how you found the missing number.	

Rule _____	
IN	OUT

Write the number sentence showing how you found the missing number.	

Rule _____	
IN	OUT

Write the number sentence showing how you found the missing number.	

Recreate one of the patterns above on the hundred chart below by coloring in the same numbers. Then, continue the pattern on the hundred chart.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100